

power saving function and others, related device control between the wireless display system and input and output peripheral device cannot be expected. The sequence of user authentication and connection verification is complicated. Hence, the system is not easy to use for the user.

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SUMMARY OF THE INVENTION

The invention is devised in the light of the above problems.

A wireless display system of the invention comprises data input and output means for input and output of data in and from an image display
 10 device, input and output data converting means for converting data format and protocol in wireless communication means, and input and output processing virtual means for making virtual data input and output process in a data processing device as if the data input and output means were connected directly. The data input and output means and input and
 15 output converting means are provided in the image display device, and the input and output processing virtual means is provided at the data processing device side. Communication is made between the image display device and data processing device, and all data about data input and output are mutually transmitted and received through the input and
 20 output data converting means and input and output processing virtual means.

A method of communication of wireless display system of the invention comprises the steps of:

- (a) entering and producing data in and from an image display
 25 device,
- (b) converting data format and protocol in wireless communication, and

(c) processing input and output in a data processing device virtually as if data input and output processing were done directly.

Step (a) and step (b) are done at the image display device side, and step (c) is done at the data processing device side. All data relating to data input and output communicated between the image display device and data processing device is processed at step (b) and step(c), and is mutually transmitted and received.

A computer program recording medium for executing communications of wireless display system of the invention includes the programs for:

- (a) entering and producing data in and from an image display device,
- (b) converting data format and protocol in wireless communication, and
- (c) processing input and output in a data processing device virtually as if data input and output processing were done directly.

Program (a) and program (b) are executed at the image display device side, and program (c) is executed at the data processing device side. All data relating to data input and output communicated between the image display device and data processing device is transmitted and received by execution of program (b) and program (c).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a configuration of wireless display system of embodiment 1 of the invention.

Fig. 2 shows an appearance of wireless display system of embodiment 1 of the invention.

Fig. 3 is a flowchart showing power saving process in wireless display system of embodiment 1 of the invention.

Fig. 4 is a flowchart showing wireless communication process in wireless display system of embodiment 1 of the invention.

5 Fig. 5 shows an appearance of wireless display system of embodiment 2 of the invention.

Fig. 6 is a flowchart showing verification process in wireless display system of embodiment 2 of the invention.

10 Fig. 7 shows an appearance of wireless display system of embodiment 3 of the invention.

Fig. 8 shows an appearance of wireless display system of embodiment 4 of the invention.

Fig. 9 shows an appearance of wireless display system of embodiment 5 of the invention.

15 Fig. 10 shows an appearance of wireless display system of embodiment 6 of the invention.

Fig. 11 shows an appearance of wireless display system of embodiment 7 of the invention.

20 DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Embodiments of the invention are described below while referring to Fig. 1 to Fig. 11.

(Embodiment 1)

25 Fig. 1 is a block diagram showing a configuration of wireless display system of embodiment 1 of the invention.

Fig. 1 shows a data processing device 101 and an image display device 106. A CPU 102 is processing means of the data processing device

101. A memory 103 and an HDD 104 are both storing means of the data processing device 101. The memory 103 temporarily stores the code and processing data to be processed in the CPU 102, and the HDD 104 stores results of processing and other data for a long period. A wireless unit 105 is wireless communication means of the data processing device 101, and wireless communications are made with the image display device 106. In this embodiment, the technology of, for example, IEEE802.11 can be employed in wireless communications.

A CPU 107 is processing means of the image display device 106. A memory 108 and a flash memory 109 are both storing means of the image display device 106. The memory 108 temporarily stores the code and processing data to be processed in the CPU 107, and the flash memory 109 stores results of processing and other data for a long period. A wireless unit 110 is wireless communication means of the image display device 106, and wireless communications are made with the data processing device 101.

A touch panel 111 and an operation button 112 are both operating means of the image display device 106. The touch panel 111 is mainly responsible for input of operation depending on coordinates, among various operations of the PC. The operation button 112 is used for operation input for fixing and establishing the input, or calling of original function incorporated in the image display device. An LCD 113 is display means of the image display device 106, and it receives and displays the image transmitted by the data processing device 101 through wireless communication, or displays the image created by the image display device 106 itself. A serial port 114 is data input and output means of the image display device 106, and data is exchanged with a serial device connected to

the port. In this embodiment, for example, the technology conforming to RS-232-C may be employed in serial communication.

In the embodiment of the invention, the input and output processing virtual means is realized by a program stored in the memory 103 of the data processing device 101 and executed by the CPU 102. For example, when the code to be executed by the CPU 102 of the data processing device 101 is composed of an operating system, and an application running on the operating system, the input and output processing virtual means is realized by a driver or resident application conforming to the specification of the operating system. The input and output processing virtual means operates when the general application requests serial communication process to the operating system. That is, the instruction for data output to the serial port or state change conforming to the specification of the operating system is converted into data format and protocol of wireless communication. In consequence, the data and protocol of wireless communication format are converted to the notice of data input from serial port or state change conforming to the specification of the operating system. In this way, the input and output processing virtual means processes input and output virtually. In this embodiment, the technology of TCP/IP protocol may be employed for data format and protocol of wireless communication.

The input and output data converting means and power saving control means are realized by programs stored in the memory 108 of the image display device 106, and executed by the CPU 107. By input and output data converting means, the input data and state change information of the serial port 114 are converted into the data format and protocol of wireless communication, and the data and protocol of wireless

communication format received in the wireless unit 110 are converted into the output data and state change instruction of the serial port 114. The power saving control means can change the power saving setting and control on/off switching of power supply of the CPU 107, wireless unit 110, touch panel 111, and LCD 113 individually.

After completion of wireless communication connection between the data processing device 101 and image display device 106, if there is any data input from the serial port 114 or state change such as signal wire change of serial port 114, the image display device 106 converts the serial data and signal wire change to the data format and protocol of wireless communication by the program on the CPU 107, and transmits to the data processing device 101 from the wireless unit 110. The data processing device 101 receives the transmitted input data of wireless communication format in the wireless unit 105. The input data is, by the CPU 102, returned from the data and protocol of wireless communication format to the original serial data and code showing the state change such as signal wire change by the input and output processing virtual program, and is handled by other program on the CPU 102. As a result, the serial input through wireless communication can be processed similarly with the serial input from the serial port incorporated in the data processing device 101.

In the case the processing result of serial input brings about a change on the display screen, the CPU 102 of the data processing device 101 creates display screen image data on the basis of the serial input data processing result. The CPU 102 transmits the differential portion or whole of screen image from the wireless unit 105 to the image display device 106. The image display device 106 displays the transmitted display screen image data in the LCD 113.

After completion of wireless communication connection between the data processing device 101 and image display device 106, if there is output data to the serial port 114 or state change instruction such as signal wire change of serial port 114, by various programs operating on the CPU 102 of the data processing device 101, the data processing device 101 starts output processing same as the serial data from the incorporated serial port. Its output processing is done through the input and output virtual program on the CPU 102. As a result, the serial output data and state change instruction such as signal wire change are converted to the data format and protocol of wireless communication, and transmitted to the image display device 106 from the wireless unit 105. The image display device 106 receives the transmitted serial output data and state change instruction such as serial signal wire change being converted to the data format and protocol of wireless communication, in the wireless unit 105. The input and output data conversion program on the CPU 107 returns the data and protocol of wireless communication format to the original serial output data and state change instruction such as serial signal wire change, and executes output to the serial port 114 or state change such as signal wire change.

As a result of transmission of serial output data, if the display screen is changed, the CPU 102 of the data processing device 101 creates display screen image data on the basis of the serial output data processing result, and transmits the differential portion or whole of screen image from the wireless unit 105 to the image display device 106. The image display device 106 displays the transmitted display screen image data in the LCD 113.

Fig. 2 shows an appearance of the wireless display system in

embodiment 1 of the invention.

In Fig. 2, a PC main body 201 corresponds to the data processing device 101, and a display 202, to the image display device 106. Further, an LCD panel 203 is display means, a touch panel 204 and an operation button 205 are input means, and a serial port connector 206 is data input and output means.

Fig. 3 is a flowchart showing power saving process at the image display device side of the wireless display system in embodiment 1 of the invention.

After starting the image display device 106 of the wireless display system, at step 301, a wait time timer is set to wait for operation by the user for a specific time (for example, 2 minutes). If operated within 2 minutes, the wait time timer is reset to continue to wait for operation at step 301. If not operated, at step 302, power saving state of first level starts. At step 302, as power saving state of first level, power supply to the LCD 113 is stopped by power saving control means, and access to the touch panel 111 is stopped. At next step 303, checking if the serial port 114 is presently usable (open) or not, it is verified if possible to transfer to power saving state of second level or not. While the serial port 114 is open, it means the communication is being made, and the process goes to step 304 to continue power saving state of first level, and if not open, the process goes to step 306 to wait for start of power saving state of second level. At step 304, checking if the operation button 112 has been operated by the user or not, and if operated, the process goes to step 307 for canceling the power saving state, and if not operated, the process goes to step 305. At step 305, checking if the serial port 114 is in non-usable (closed) state or not, it is verified whether possible or not to transfer to the power saving state of

second level. If the serial port 114 is not closed, it means the communication is being made, and the process goes to step 304 to continue power saving state of first level, and if already closed, the process goes to step 306 to wait for start of power saving state of second level. Step 306 is to wait for operation by the user on the operation button 112 until lapse of a specific time (for example, 5 minutes) of the wait time timer set at step 301. If operated within 5 minutes, the process goes to step 307, and if not operated, the process goes to step 308 to transfer to power saving state of second level. At step 307, power supply to the LCD 113 is resumed to light up by the power saving control means. By resuming access to the touch panel 111, the power saving state of first level is canceled, the wait time timer is reset, and the process returns to step 301. At step 308, as the power saving state of second level, the power source of the image display device 106 is turned off, or, by lowering the power consumption of the parts, the power saving control including the remaining processing means and wireless communication means is started.

Fig. 4 is a flowchart showing wireless communication process of the wireless display system in embodiment 1 of the invention.

When wireless communication starts after completion of wireless connection between the data processing device 101 and image display device 106, the communication rate of the following data is measured at step 401. The data is the sum of all data of wireless communications, that is, the user's operation data entered through the touch panel 111 and operation button 112, the screen image data as a result of data processing by the data processing device 101 according to the user's operation and data input and output relating to the serial port 114, the input data from the serial port 114, and the output data to be issued by the data processing

device 101 by using the serial port 114. When the communication rate of result of measurement exceeds a specific rate (for example, 75%) of the effective communication rate in the employed wireless communication system, updating of the screen image data is decimated at a specific interval at step 402. For example, by setting the updating rate to about half of usual, the rate of communication data of wireless communication is lowered. As far as the communication rate measured at step 401 does not exceed a specific rate of the effective communication rate, the communication continues. At step 403, as a result of decimation of screen updating, if the communication rate of all data becomes lower than a specific rate (for example, 50%) of the effective communication rate of the employed wireless communication system, decimation of updating of screen image data is canceled at step 404, and communication continues.

(Embodiment 2)

Embodiment 2 of the invention is explained by referring to Fig. 5 and Fig. 6.

Embodiment 2 differs from embodiment 1 in that a barcode reader incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, and wireless communication process are same as in embodiment 1, and duplicate explanation is omitted.

Fig. 5 shows an appearance of wireless display system of embodiment 2 of the invention.

In Fig. 5, a PC main body 501 corresponds to the data processing device, and a display 502, to the image display device. An LCD panel 503 is display means, a touch panel 504 and an operation button 505 are input means, and a barcode reader 506 is data input and output means. In Fig.

5, the barcode reader 506 is connected to the display 502 through a cable, but it may be also incorporated in the display 502.

Fig. 6 is a flowchart showing validation process in wireless display system of embodiment 2 of the invention.

5 After starting the PC main body 501, the power source of the display 502 is turned on, and the barcode reader 506 connected to the display 502 is started to set in barcode reading state. At step 601, the user, using the barcode reader 506, reads the barcode of the object printing the barcode for identifying the user such as the ID plate. At step 602, from the
10 reading result, the password for verifying connection and the user ID and password for verifying the user are acquired.

 In the embodiment, in order to acquire the password for verifying connection and the user ID and password for authenticating the user, a table for acquiring the password for verifying connection and the user ID
15 and password for authenticating the user from the data being read by the barcode reader 506 is preliminarily stored in the storage means of the display 502. Aside from this method of referring to the table by the data of reading result, there is also a method of taking out the password for verifying connection and the user ID and password for authenticating the
20 user contained in the reading result data directly from the reading result data.

 When the password for verifying connection and the user ID and password for authenticating the user are acquired, at step 603, wireless connection process between the display 502 and PC main body 501 is
25 started. Once wireless connection process is started, at step 604, wireless connection is verified by using the password for verification of wireless connection. For verification of wireless connection, a general verification

(Embodiment 3)

Embodiment 3 differs from embodiment 1 in that a tester incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, and wireless communication process are same as in embodiment 1, and duplicate explanation is omitted.

In Fig. 7, a PC main body 701 corresponds to the data processing
 25 device, and a display 702, to the image display device. An LCD panel 703
 is display means, a touch panel 704 and an operation button 705 are input
 means, and a tester 706 is data input and output means. In Fig. 7, the

(Embodiment 4)

Embodiment 4 of the invention is explained while referring to Fig.

5 8.

Embodiment 4 differs from embodiment 2 in that a digital camera incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, wireless communication process, and verification process are same as in embodiment 2, and duplicate explanation is omitted.

Fig. 8 shows an appearance of wireless display system of embodiment 4 of the invention.

In Fig. 8, a PC main body 801 corresponds to the data processing
 15 device, and a display 802, to the image display device. An LCD panel 803
 is display means, a touch panel 804 and an operation button 805 are input
 means, and a digital camera 806 is data input and output means. In Fig. 8,
 the digital camera 806 is connected to the display 802 through a cable, but
 it may be also incorporated in the display 802.

20 (Embodiment 5)

Embodiment 5 of the invention is explained while referring to Fig.

9.

Embodiment 5 differs from embodiment 2 in that a card reader incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, wireless communication process, and verification process are same as in embodiment 2. and

duplicate explanation is omitted.

Fig. 9 shows an appearance of wireless display system of embodiment 5 of the invention.

In Fig. 9, a PC main body 901 corresponds to the data processing device, and a display 902, to the image display device. An LCD panel 903 is display means, a touch panel 904 and an operation button 905 are input means, and a card reader 906 is data input and output means. In Fig. 9, the card reader 906 is connected to the display 902 through a cable, but it may be also incorporated in the display 902.

10 (Embodiment 6)

Embodiment 6 of the invention is explained while referring to Fig. 10.

Embodiment 6 differs from embodiment 2 in that a scanner incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, wireless communication process, and verification process are same as in embodiment 2, and duplicate explanation is omitted.

Fig. 10 shows an appearance of wireless display system of embodiment 6 of the invention.

In Fig. 10, a PC main body 1001 corresponds to the data processing device, and a display 1002, to the image display device. An LCD panel 1003 is display means, a touch panel 1004 and an operation button 1005 are input means, and a scanner 1006 is data input and output means. In Fig. 10, the scanner 1006 is connected to the display 1002 through a cable, but it may be also incorporated in the display 1002.

(Embodiment 7)

11.

Embodiment 7 differs from embodiment 1 in that a GPS receiver incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, and wireless communication process are same as in embodiment 1, and duplicate explanation is omitted.

Fig. 11 shows an appearance of wireless display system of embodiment 7 of the invention.

In Fig. 11, a PC main body 1101 corresponds to the data processing device, and a display 1102, to the image display device. An LCD panel 1103 is display means, a touch panel 1104 and an operation button 1105 are input means, and a GPS receiver 1106 is data input and output means. In Fig. 11, the GPS receiver 1106 is connected to the display 1102 through a cable, but it may be also incorporated in the display 1106.

Herein, the wireless display system and its communication method of the invention are specifically described by referring to embodiments. According to the invention, the input and output peripheral devices can be used at the displays side of the wireless display. Further, the display function and the input and output peripheral device function cooperate, so that power saving control, easy connection, and verification sequence can be realized.

The program recording medium of the invention has recorded the program for the computer to execute this communication method.